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Royal Commission on National Passenger Transportation

***The Cost of Inter-City Travel by Private Motor Vehicle***

Pilorusso Research & Consulting Inc.

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## **1. INTRODUCTION**

The cost per kilometre of inter-city travel by private passenger cars and light trucks<sup>1</sup> can be divided into fixed and variable components. Fixed costs are those that are incurred regardless of the number of kilometres that a car or light truck is driven. The main fixed cost components are:

- capital costs that take into account the cost of capital to purchase the car or light truck and the loss in value as the car or light truck ages,
- insurance premiums, and
- licence fees.

Variable costs are directly proportional to the number of kilometres driven. The main variable cost components are:

- fuel, and
- maintenance.

To the extent that used cars and light trucks that have been driven fewer kilometres command a higher re-sale price than otherwise comparable used cars or light trucks, a portion of the capital costs of car or light truck ownership can be considered to be variable.

Each of the cost components for cars and light trucks are derived below.

## **2. CARS**

### **2.1 Capital Costs**

Selected characteristics of the Canadian passenger car fleet at the end of 1990, including the fleet average capital cost per kilometre, are shown in Table 1 on the following page. Table 1 contains data only for cars up to 10 years old. Data published in Statistics Canada 53-007, Fuel Consumption Survey, indicate that cars that are older than 10 years account for less than 10 percent of the total distance travelled by the fleet. While it is not possible to determine from available data, it seems to be a reasonable assumption that older cars are used disproportionately less for inter-city travel than newer cars. That is, if there is a choice between an older and a newer car to use for an inter-city trip, the newer car would likely be chosen. Or, if the choice is between using an old, unreliable car and an alternative

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<sup>1</sup> The term "light trucks" includes pickup trucks and vans.

transportation mode, the latter may be chosen. For these reasons and because of the difficulty in estimating depreciation and the cost of capital for cars older than 10 years, they are not included in Table 1.

The estimated number of cars in the active fleet are shown in the second column of Table 1. To arrive at the estimates the estimated number of cars that have been scrapped were subtracted from the number of retail sales reported for the year. Scrappage rates are based on registration data that has been disaggregated by model year.<sup>2</sup> Retail sales for 1981 to 1989 are from Statistics Canada 63-007, New Motor Vehicle Sales. The retail sales figure for 1990 is from the trade journal, Automotive News (January 28, 1991). The scrappage rate is very low for cars that are less than seven or eight years old. For cars in this age range virtually all of the scrappage is accounted for by cars that have been damaged beyond repair in accidents. Cars begin to reach the end of their service life after seven to eight years, and scrappage rates begin to rise rapidly thereafter.

Estimates of the average number of kilometres travelled are shown in the third column of Table 1. The estimates are based on data for 1981 to 1988 published in Statistics Canada 53-007, Fuel Consumption Survey. The data were used to estimate the number of annual vehicle kilometres travelled by vehicle age and the growth rate in the average annual vehicle kilometres travelled by the entire fleet. As Statistics Canada has discontinued the Fuel Consumption Survey, empirical data for 1989 and 1990 are not available. In order to arrive at the estimates for 1989 and 1990 that are shown in Table 1, a growth rate of 1.4 percent per year, which is the average annual growth rate of the previous eight years, was used.

The average retail price data shown in the fourth column of Table 1 are from Statistics Canada 63-007, New Motor Vehicle Sales.

The figures shown in the fifth column entitled "Depreciation in 1990" represent the average loss in value of cars bought in 1990 and each of the nine previous years, based on transaction prices of used cars. In order to estimate a depreciation schedule for cars, transaction prices for used cars published in the Canadian Red Book were analyzed to determine the percentage of the original value of cars that is lost every year over their lifetime. The results of the analysis showed a surprisingly consistent pattern of an average loss of 11 percent per year of the initial cost of a car, on a declining balance basis. For example, the value at the beginning of 1990 of the average new car sold in 1989 was \$14 899 [ $16\ 740 \times (1 - 0.11)$ ]. At the end

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<sup>2</sup> Due to limitations in registration data, scrappage rates could not be calculated directly from registration data; scrappage rates had to be estimated from the trend. Details of how scrappage rates were estimated are presented in the Appendix.

of 1990 the value of the same car was \$13 260 [ $14\ 899 \times (1 - 0.11)$ ]. The depreciation is the difference of \$14 899 and \$13 260 or \$1 639. Since the depreciation estimates are based on 1990 transaction prices, inflation is included in the estimates. The Appendix contains further details on the calculation of depreciation.

The actual financial loss to a consumer if he or she traded in a car that was purchased new after one year of use would be considerably more than 11 percent of its retail price. If the car was traded in to a dealer its value would be based on the wholesale price which is typically 10 to 12 percent less than the retail price at which the dealer would sell it. The 11 percent depreciation rate is based on retail transaction prices. In addition the retail sales tax, which ranges from zero in Alberta to 12 percent in Newfoundland, would not be recovered when the car is traded in or sold privately. If a car that was purchased new was traded in after one year of use in, for example, Ontario, where the retail sales tax is 8 percent, the actual cost to the consumer would be 29 to 30 percent of the retail price of the car.

The depreciation and cost of capital estimates shown in Table 1 include the costs to the consumer of the retail sales tax and trading his or her car in to a new or used car dealer rather than selling it privately. Data from the Used Car Dealers Association indicates that a car is sold, on average, about three times before it is scrapped. For the purposes of estimating the costs of sales taxes and the dealers' margin on trade-ins it is assumed that all cars that were five and nine years old were sold in 1990. (It is also implicitly assumed that none of the other cars changed hands during 1990 and that all of the cars would change hands once more, on average, before being scrapped.)

A weighted average Canadian retail sales tax of 7.4 percent of the average cost of new cars and the average retail transaction price of cars five and nine years old was added to the depreciation cost in the years in which the tax was paid. (It should be noted that this will overstate actual sales taxes paid since there is a tendency to underestimate the purchase price by some used car buyers in order to avoid paying the full amount of the sales tax due.) Since none of the retail sales tax can be recovered by the consumer when a car is sold, the entire amount of the tax is considered to be a cost in the year in which it was paid.

Data published by the Canadian Automobile Association in Autopinion 91 shows that about 60 percent of used cars are purchased from new and used car dealers. Assuming that the average dealer mark-up is 11 percent, an additional 6.6 percent ( $11 \times 0.60$ ) has been added to the average transaction price of cars that were five and nine years old in 1990 to account for the transfer of funds from consumers to dealers when used cars change hands.

The cost of capital, shown in the sixth column, is estimated by multiplying the average value of a car, including the retail sales tax where applicable, by a real interest rate of 10 percent.

Based on the above, the fleet average capital cost (depreciation plus the cost of capital) is \$0.128 per kilometre.

## 2.2 Insurance Premiums

Statistics Canada 62-555, Family Expenditure in Canada reported an average insurance premium of \$526 in 1986. The component of the consumer price index (Statistics Canada 62-001, The Consumer Price Index) that tracks private transportation insurance premiums was at 126.1 (1986 = 100) as of mid-1990. Therefore, the average insurance premium paid by Canadian households in 1990 was \$663 ( $526 \times 126.1$ ).

The family expenditure data reported by Statistics Canada for operation of cars and light trucks is presumably for all of the motor vehicles in the household. The average expenditure for automotive fuels reported in Statistics Canada 62-555, Family Expenditure in Canada was compared to the average amount spent on fuel per passenger car that was reported in Statistics Canada 53-007, Fuel Consumption Survey. The two figures were within one percent of each other. Thus it appears that the average number of privately-owned motor vehicles per household is one. It is, therefore, assumed that the average insurance premium paid by Canadian households reported in Statistics Canada 62-555, Family Expenditure in Canada is a reasonable estimate of the average insurance premium for one vehicle.

The Insurance Bureau of Canada reported an average insurance premium of \$501 for personal use automobiles in the 1988 premium year in 1988 Automobile Insurance Experience (Green Book). When adjusted for inflation the estimated average premium paid in 1990 was \$552. The estimate based on Insurance Bureau of Canada is \$111 less than the estimate based on Statistics Canada 62-555, Family Expenditures in Canada. Part of the reason for the discrepancy is that the data reported to the Insurance Bureau of Canada is for premiums earned by the insurers, and does not include the commission earned by the insurance agent. Whereas respondents to the Statistics Canada survey would have reported the total amount paid to the insurance agent. This still leaves some of the difference unaccounted for; however, when spread over an average of 17 600 kilometres per year the difference is small: \$0.031 per kilometre for the Insurance Bureau of Canada estimate compared to \$0.038 per kilometre for the Statistics Canada estimate.

### 2.3 Registration and Licence Fees

The weighted average Canadian annual registration and licence fees were calculated from data in Digest of Motor Laws (American Automobile Association, 1990). The weighted average registration and licence fees total \$64 per year.

### 2.4 Variable Costs

Fuel and maintenance costs are derived from the same Statistics Canada publications and in the same way as outlined above for the cost of insurance premiums. Fuel and maintenance costs were \$1 230 and \$409, respectively, per car, on average, in 1990.

The average cost of gasoline in 1990, as estimated from data in Statistics Canada publications 62-555, Family Expenditure in Canada and 62-001, The Consumer Price Index, was \$0.567 per litre. Therefore, the average passenger car fuel consumption rate in 1990 was 12.3 litres per 100 kilometres ( $100 \div 17\ 600 \times 1\ 230 \div 0.567$  \$/litre). These estimates are consistent with fuel costs and consumption rates reported in Statistics Canada 57-003 Fuel Consumption Survey.

Testing by Transport Canada and others show that the fuel consumption rate in highway driving is approximately 20 percent lower than the average. Therefore, the per kilometre cost of fuel during inter-city trips during 1990 was \$0.056 ( $12.3 \times 0.8 \times 0.567 \div 100$ ).

The average per kilometre cost for passenger car maintenance during 1990, based on Statistics Canada data, was \$0.023 ( $\$409 \div 17\ 600$ ).

The Canadian Automobile Association (CAA) reported in Autopinion 91 an average repair and maintenance cost of \$0.028 per kilometre, based on a survey of its members. Since the respondents to the CAA survey are members of an automobile club and are self-selected participants on the survey, the CAA data may be biased towards consumers who spend more than average on maintenance and repairs. However, this could not be verified.

The market value of a used car is affected to some extent by the number of kilometres that it has accumulated. While most of the capital cost per kilometre of car ownership is fixed; that is, it is directly proportional to the age of the car, a portion can be attributed to use and, therefore, be considered variable. The difference in the market price between low-use and high-use cars that are otherwise comparable depends on the age of the car and the number of kilometre less or more than the average, for its age, that it has accumulated. According to a chart in the Canadian Red Book that

shows the impact of total kilometres travelled on the incremental gain or loss in value of used cars, the incremental loss in value for cars one to three years old is about \$0.02 to \$0.03 per kilometre. For older cars the incremental loss in value falls to about \$0.01 to \$0.02 per kilometre. In general the incremental cost per kilometre is highest for travel that occurs when a car's total kilometres is about 5 000 to 10 000 plus or minus the average.

The quality of the available data on the loss in value of a car for incremental use is such that definitive findings are not possible. However, a rule of thumb that can be used is that the incremental capital cost of travel above or below the average number of kilometres driven is about \$0.02 per kilometre.

## **2.5 Total Cost per Kilometre of Inter-City Passenger Car Travel**

The costs per kilometre shown below are based on an average distance travelled in 1990 of 17 600 kilometres. For the sake of consistency the estimates for insurance and maintenance costs are based on data from Statistics Canada 62-555 Family Expenditures in Canada. If the alternate estimates, based on Insurance Bureau of Canada data for insurance cost and CAA data for maintenance cost were used the total would be virtually the same since the former is slightly higher than the Statistics Canada estimate by about the same amount that the latter is lower than the Statistics Canada estimate.

### **Fixed costs**

Capital cost	\$0.128
Insurance	0.038
Registration and licence	0.004

### **Variable costs**

Fuel	0.056
Maintenance	0.023

### **TOTAL**

\$0.249

The above estimate includes the full average capital cost per kilometre. If it is assumed that consumers buy cars primarily for commuting to work, shopping, and other trips that begin and end at home, inter-city travel may be considered "marginal" travel for the purpose of allocating the fixed cost of ownership. In marginal travel, only the marginal (that is, variable) costs

apply. The per kilometre cost of highway passenger car travel at the margin in 1990 was approximately \$0.10 ( $0.02 + 0.056 + 0.023$ ).

## 2.6 Comparison to Other Estimates

The most-commonly-quoted estimates of the costs to operate cars in Canada are those compiled by Runzheimer Canada Inc. A summary of the Runzheimer estimates is published by the CAA in the leaflet Car Costs. Runzheimer's estimated per kilometre costs for various car sizes are shown below.

Car Size	Cost Per Kilometre
Sub-Compact	\$0.235 to 0.269
Compact	\$0.252 to 0.290
Mid-Size	\$0.284 to 0.329
Full-Size	\$0.301 to 0.347

The range in the per-kilometre costs reflects the difference in costs from the highest-cost province, Quebec, to the lowest-cost province, Alberta.

The Runzheimer costs are generally higher than the average cost for the Canadian car fleet presented above. The main reason for the difference is that the Runzheimer estimates are for new (1990 model) cars only, while the average cost for the Canadian fleet is for all cars on the road. Most of the difference is accounted for by the higher depreciation cost for new cars than the fleet average. The other significant difference is that the Runzheimer estimates include the cost of full insurance coverage, while only a portion of the cars in the Canadian fleet carry full coverage. Operating (variable) costs used by Runzheimer are very close to the fleet averages shown above. Runzheimer bases its costs on 24 000 kilometres per year, which is considerably higher than the fleet average, but is a realistic estimate for new cars, many of which are used for business purposes. Although the Runzheimer estimates of fixed costs are spread over more kilometres, the per-kilometre fixed costs are higher than the estimated fleet average.

## 3. LIGHT TRUCKS

Wherever possible the same methodology and data sources as described above for passenger cars were used to estimate the cost components for private light trucks in inter-city travel. The data for insurance, registration and licence, and maintenance costs were not desegregated by vehicle type. The data for these costs components are averages for all "private

"automobiles" which includes passenger cars, pickup trucks, sport utility vehicles and vans. As a distinction between cars and light trucks cannot be made for these cost components, the same values will be used for light trucks as those used for cars. The actual differences would be very small in any case.

There are some minor differences in the capital cost per kilometre between cars and light trucks, and since light trucks are less fuel efficient than cars the cost per kilometre of fuel for light trucks is slightly higher than for cars. The derivations of the capital and fuel costs per kilometre for light truck are presented below, followed by a summary of the total costs per kilometre of inter-city light truck travel.

### 3.1 Capital Costs

Selected characteristics of the Canadian light truck fleet, as of the end of 1990, are shown in Table 2. The definition of "light truck" used to select vehicles for inclusion in the table was pick-up trucks, vans and sport utility vehicles with gross vehicle weight ratings of 2 722 kilograms (6,000 pounds) or less. Most, but not all, private use light trucks are included in this weight category. (Since the average cost per kilometre is a weighted average it is less important to have precise estimates of the number of light trucks in the fleet than it is to know the relative proportions of light trucks of each model year that are in the fleet.)

The numbers of light trucks in the fleet, which are shown in the second column of Table 2, are the number of new light trucks registrations reported each year by R.L. Polk & Company minus the estimated number that have been scrapped. As the data needed to estimate scrappage rates for light trucks are not available they were assumed to be the same as passenger car scrappage rates. The average age of the light truck fleet is less than the average age of the passenger car fleet. This reflects the growing popularity of mini-vans and sports utility vehicles as a substitute for the traditional family car over the past decade.

Data in Statistics Canada 53-007 Fuel Consumption Survey indicate that, on average, light trucks are driven about five percent more kilometres per year than passenger cars of the same age. However, because of the higher proportion of newer, higher-use vehicles in the light truck fleet, the average annual kilometres travelled by light trucks is about 8 percent higher than the average for cars; 19 100 versus 17 600 kilometres per year.

Statistics Canada 63-007, New Motor Vehicle Sales reports only the total number of commercial vehicles sold and their total value. In order to calculate the average retail price of light trucks, the number of commercial vehicles with gross vehicle ratings greater than 2 722 kilograms (6,000

pounds) registered in each year and their estimated value were subtracted from the unit sales and total value data, and the average retail price of light trucks was then calculated.

While light trucks cost slightly more on average than cars, they do not lose their value as quickly. An analysis of retail prices of used light trucks in the Canadian Red Book shows a depreciation rate of about nine percent per year compared to 11 percent for cars.

The depreciation and cost of capital estimates shown in Table 2 include the cost of the retail sales tax and the additional cost of trading in used light trucks to dealers in the same way as described above for cars.

### **3.2 Fuel Costs**

The average fuel consumption rate for light trucks and vans reported in Statistics Canada 53-007 Fuel Consumption Survey is 16.3 litres per 100 kilometres. Assuming that the fuel consumption rate for highway driving is 20 percent less than the average fuel consumption rate (that is, by the same amount as cars) the cost per kilometre of fuel for light trucks during inter-city trips in 1990 was \$0.074 ( $16.3 \times 0.8 \times \$0.567 \div 100$ ).

### **3.3 Total Cost per Kilometre of Inter-City Light Truck Travel**

The cost per kilometre shown below are based on an average distance travelled in 1990 of 19 100 kilometres.

#### **Fixed costs**

Capital cost	\$0.113
Insurance	0.035
Registration and licence	0.003

#### **Variable costs**

Fuel	0.074
Maintenance	0.023

<b>TOTAL</b>	<b>\$0.248</b>
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The insurance and registration and licence costs per kilometre are slightly lower for light trucks than cars due to the higher average annual distance travelled by light trucks. Capital costs and fuel costs for light trucks also

differ somewhat from those for cars. However, the estimated total costs of inter-city travel by light truck and cars are virtually identical.

The marginal cost of light truck highway use, including only the use-dependent rather than time-dependent components of depreciation, would be about \$0.12 per kilometre (i.e.  $0.020 + 0.074 + 0.023$ ), somewhat higher than that estimated for passenger car use.

## APPENDIX

### NOTES ON THE CALCULATIONS

#### Estimation of Scrappage Rates of Cars

The arithmetic of estimating the number of cars of each model year that had been scrapped between the time that they were new and 1990 is quite straightforward. The fraction that has been scrapped is equal to one minus the fraction that "survive". The surviving fraction of cars in the fleet of any given model year is equal to the number that are registered and licensed by the provinces and territories divided by the number that were originally sold.

Passenger car survival rates that are calculated from best-available registration and retail sales data are shown in the top bar graph of Figure A1 on the next page. There are some obvious problems with the bar graph: the survival fraction for 1988 is greater than 1.0 which is not possible and the survival fractions for 1989, 1987 and 1986 are far lower than can be reasonably expected, given the relatively small number of late model cars that are damaged beyond repair in accidents.

Retail sales statistics are reasonably accurate, but registration statistics are notoriously inaccurate. Registration statistics change every year when licensed are renewed, when cars are sold, when cars are retired from the fleet, when a car's registration is changed from one province to another and when used cars are exported or imported. Provincial registration systems apparently cannot keep abreast of the changes, and as a result, estimates of the number of cars in the active fleet that are based on registration data have a high margin of error.

While the survival fractions shown in the top bar chart cannot be used directly, the smoothed trend in survival fraction by model year that is evident can be. Survival fractions that were based on estimated data that conforms to the smoothed trend were used to calculate the number of cars in the fleet shown in the second column of Table 1. The smoothed survival fractions are shown in the bottom bar chart in Figure A1.

FIGURE A1

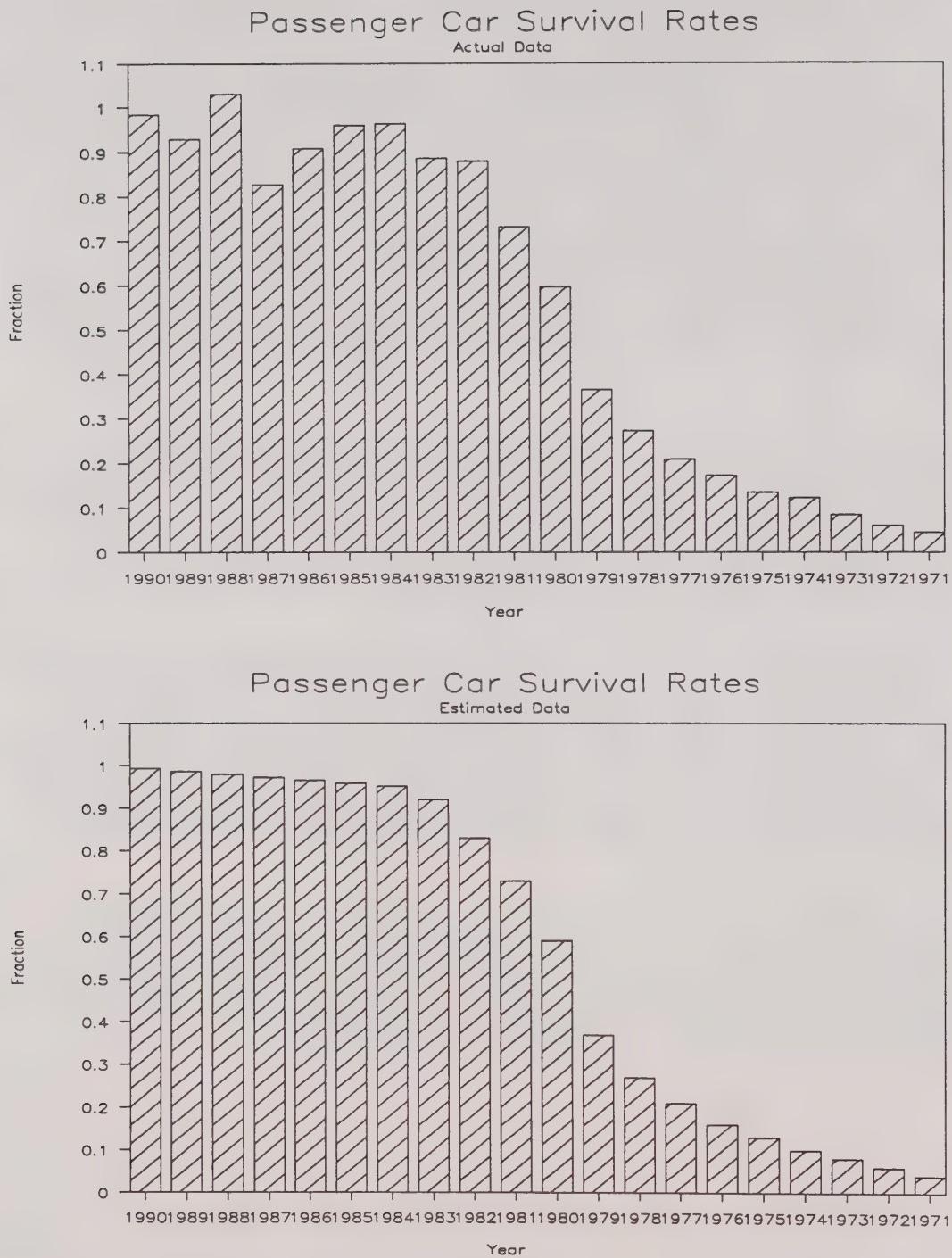


Table 1

## CALCULATION OF DEPRECIATION AND COST OF CAPITAL FOR THE CANADIAN PASSENGER CAR FLEET

## **Estimation of Depreciation and The Cost of Capital**

Table A1 shows the average retail transaction price of cars over a ten year life. The transaction prices are based on a depreciation rate of 11 percent per year on a declining balance. Since the depreciation and cost of capital estimates are for 1990, the average retail transaction price for a 1990 model year is considered to be the new price, for a 1989 model year car the average retail transaction price is the one shown in the column labelled year 1, etc.

Depreciation is calculated as follows:

- 1990 - the depreciation is equal to 11 percent of the new car cost plus the full amount of the average sale tax of 7.4 percent.
- 1986 and 1982 - the depreciation as a percent of the average retail transaction price is equal to 11 percent for loss in value plus 7.4 percent for retail sales tax plus 6.6 percent for dealer markup.
- Other years - the depreciation is equal to 11 percent of the average retail transaction price.

The cost of capital is calculated as follows:

- 1990, 1986, and 1982 - the cost of capital is equal to the 10 percent of the average retail transaction price plus 7.4 percent retail sales tax.
- Other years - the cost of capital is equal to 10 percent of the average retail transaction price.



